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• Mitani, Katsuaki
Ibaraki-shi, Osaka 567 (JP)

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(74) Representative: Crawford, Andrew Birkby et al
A.A. THORNTON & CO.
Northumberland House
303-306 High Holborn
London WC1V 7LE (GB)

(71) Applicant: MATSUSHITA ELECTRIC INDUSTRIAL
CO., LTD.
Kadoma-shi, Osaka 571 (JP)

(72) Inventors:
• Aoki, Satoshi
Kadoma-shi, Osaka 571 (JP)

(54) Rear projection screen

(57) Rear projection screen having a lenticular lens sheet (1) and a Fresnel lens (2) facing to each other and mounted on a rectangular frame (3).

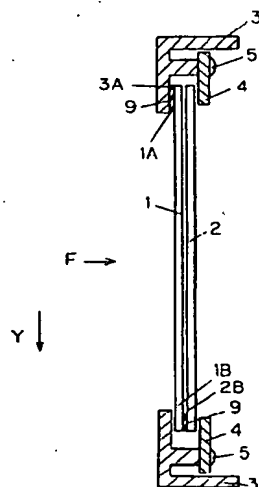
In a first embodiment, the lenticular sheet (1) and the Fresnel lens (2) are attached to each other along their bottom edges (1B, 2B) by means of an adhesive (9). The upper edge (1A) of the lenticular sheet is suspended to the frame (3), so that the lenticular sheet is tensed downwards by the weight (gravity) of the Fresnel lens (2), whose upper edge is free.

In a second embodiment the lenticular lens sheet (11) is freely placed between a transparent front plate (10) and the Fresnel lens (12), which are both attached to the frame.

Both embodiments enable the lenticular sheet to have thermal expansion without suffering surface deformations.

Fig. 1

- | | |
|---|---|
| 1 Lenticular Lens Sheet | 2B Lower Part of Light Radiant Side of Fresnel Lens Sheet |
| 1A Upper Part of Light Radiant Side of Lenticular Lens Sheet | 3 Framework |
| 1B Lower Part of Light Incident Side of Lenticular Lens Sheet | 4 Mounting Hardware |
| 2 Fresnel Lens Sheet | 5 Screw |
| | 9 Double-Sided Adhesive Tape |



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Description

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a light transmission type screen device for use in projection type television receivers and the like for magnification and projection of images by means of lenses.

Description of the Prior Art

As shown in Fig. 4, a prior art screen device has a structure wherein a screen comprising a lenticular lens sheet 101 and a Fresnel lens sheet 102 is fixed by means of mounting arrangements.

More specifically, the lenticular lens sheet 101 and Fresnel lens sheet 102 are put together by use of adhesive tapes 109 and the resulting assembly is fixed onto a framework 104 by means of mounting hardware 105, screws 106 and the like.

However, this method of mounting causes the lenticular lens sheet 101 that has a large degree of extension and shrinkage by temperature changes or a large expansion coefficient to become wavy when the lenticular lens sheet 101 and Fresnel lens sheet 102 are pressed on the framework 104 too strongly, and gaps are created between the lenticular lens sheet 101 and the Fresnel lens sheet 102. In other words, what is called an air gap phenomenon occurs, thereby causing inconsistencies in color.

In order to solve the foregoing problems, new structures have been proposed in the Japanese Published Unexamined Patent Application Nos. 108236/91, 70645/92 and 85886/92. These new structures will be explained in the following:

Fig. 5 shows the structure as disclosed in the foregoing Published Unexamined Patent Application No. 108236/91. One side of a screen 201 is fixed onto a framework 202 and the opposing side of the screen 201 is applied with a pulling force through jigs 203 in accordance with temperature changes so that creation of air gaps is prevented by pulling the screen 201 constantly.

Fig. 6 shows the structure as disclosed in the foregoing Published Unexamined Patent Application No. 85886/92.

Here, instead of the jigs as used in the foregoing to apply a pulling force to the screen, rollers 303 are provided on the side of a screen 301 opposing to one side where the screen 301 is fixed onto a framework 302 by means of mounting hardware 304. When the screen 301 is expanded or shrunk by temperature changes, the rollers 303 rotate according to the expansion or shrinkage of the screen 301 and hold the screen 301 firmly, thereby fixing the screen 301 securely onto the framework 302 and at the same time absorbing the expansion and shrinkage of the screen 302 caused by temperature

changes.

Fig. 7 shows the structure as disclosed in the foregoing Published Unexamined Patent Application No. 70645/92, wherein the upper part of a lenticular lens sheet 401 and a Fresnel lens sheet 402, both being put together there by means of a double-sided adhesive tape, is fixed onto a framework 403 by means of mounting hardware 404, and the lower part thereof is held by squeezing between the framework 403 and the mounting hardware 404, thus bringing the lenticular lens sheet 401 into a close contact with the Fresnel lens sheet 402 due to its own weight when the expansion or shrinkage of the screen occurs by temperature changes.

However, all these structures tend to be rather complicated since jigs to provide a pulling force to the screen and rollers to absorb the expansion or shrinkage of the screen are required, and also tend to be bulky in order to accommodate the jigs and rollers, thus presenting problems.

Furthermore, the structure according to the foregoing Published Unexamined Patent Application No. 70645/92 relies on the ability of the lenticular lens sheet 401 to return to its original shape when it is expanding again after the lenticular lens sheet 401 has once shrunk by a temperature change. However, when spacings between lenticular lenses of the lenticular lens sheet 401 are very small, the lenticular lens sheet 401 looks like a plain sheet of film and is very light in weight, thereby causing the recovery to the original shape by its own weight to become uncertain and leading to a problem of air gap formation.

SUMMARY OF THE INVENTION

The object of the present invention is to provide a screen device of a compact structure, whereby images with no inconsistencies in color are realized by preventing a lenticular lens sheet from becoming wavy due to temperature changes and keeping the lenticular lens sheet and Fresnel lens sheet securely in contact with each other.

A first structure of the screen device comprises:

a screen composed of a lenticular lens sheet and a Fresnel lens sheet, the lower part of each being fixed with each other integrally; and

a framework with the upper part thereof being fixed integrally to the upper part of the light radiant side surface of the foregoing lenticular lens sheet and with the lower part thereof not being fixed to the foregoing lower part of the screen that is integrally structured, and

prevents slack in the foregoing lenticular lens sheet due to temperature changes from occurring through the weight of the foregoing Fresnel lens sheet imposed on the lower part of the foregoing lenticular

lens sheet.

A second structure of the screen device comprises:

a screen composed of a lenticular lens sheet and a Fresnel lens sheet, both not being fixed integrally with each other;

and

a light transmissive panel, which the foregoing screen is mounted on and is put together integrally with the foregoing Fresnel lens sheet by means of mounting hardware with a specified clearance left on its light radiant side, and

has the foregoing lenticular lens sheet hanging freely within the foregoing clearance created between the foregoing light transmissive panel and Fresnel lens sheet.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a cross-sectional view of a screen device as a first exemplary embodiment of the present invention.

Fig. 2 is an exploded perspective view of a screen device as a second exemplary embodiment of the present invention.

Fig. 3 is a cross-sectional view of the screen device of Fig. 2 after assembly.

Fig. 4 is a cross-sectional view of a prior art screen device.

Fig. 5 is a perspective view of a prior art screen device.

Fig. 6 is a cross-sectional view of a prior art screen device.

Fig. 7 is a cross-sectional view of a prior art screen device.

DETAILED DESCRIPTION OF THE INVENTION

Next, a few exemplary embodiments of the present invention of a screen device will be explained with the help of drawings.

(Example 1)

Fig. 1 is a cross-sectional view of a screen device as a first exemplary embodiment of the present invention.

A screen device of the present invention comprises a screen composed of a lenticular lens sheet 1 and a Fresnel lens sheet 2, a framework 3 and mounting hardware 4 that is installed on the light incident side of the Fresnel lens sheet 2 to prevent the screen from becoming disengaged off the framework 3 even when an external force F is applied in the direction of the normal to

the foregoing screen.

The steps needed to assemble the screen device are as follows:

The lower part 1B of the light incident side of the lenticular lens sheet 1 is cemented to the lower part 2B of the light radiant side of the Fresnel lens sheet 2 by means of a double-sided adhesive tape 9 or the like, for example, and the upper part 3A of the framework 3 and the upper part 1A of the light radiant side of the lenticular lens sheet 1 are cemented together similarly by means of a double-sided adhesive tape 9.

Then, the mounting hardware 4 is installed on the light incident side of the Fresnel lens sheet 2 and fastened to the framework 3 by means of a screw 5.

Accordingly, the screen composed of the lenticular lens sheet 1 and Fresnel lens sheet 2 is securely mounted on the framework 3.

At this time, a clearance is created between the light incident surface of the Fresnel lens sheet 2 and the mounting hardware 4, and also another clearance is created between the lower part of the screen, where the lenticular lens sheet 1 and Fresnel lens sheet 2 are fixed integrally, and the framework 3.

The screen device thus produced has a clearance between the lower part of the lenticular lens sheet 1 and the framework 3, and the upper part of the light incident side of the lenticular lens sheet 1 is not cemented to the upper part of the light radiant side of the Fresnel lens sheet 2. Therefore, even when the lenticular lens sheet 1 is expanded or shrunk by temperature changes, it can move freely. In addition, the weight of the Fresnel lens sheet 2 is imposed on the lower part of the lenticular lens sheet 1, thereby a constant pulling force being applied to the lenticular lens sheet 1 in the direction of gravity (Y-) to make the lenticular lens sheet 1 and the Fresnel lens sheet 2 keep in close contact with each other.

Therefore, it becomes possible to obtain stabilized images that are free of inconsistencies in color even when the ambient temperature changes. No additional space is required in particular for the above arrangement, and the dimensions of the framework 3 are kept to the smallest possible limit that is needed to house the screen.

(Example 2)

Fig. 2 is an exploded perspective view of a screen device as a second exemplary embodiment of the present invention, and

Fig. 3 is a cross-sectional view of Fig. 2 after assembly.

As shown in Fig. 3, the screen device of the present invention comprises: a light transmissive panel 10 housing a screen composed of a lenticular lens sheet 11 and a Fresnel lens sheet 12; and screen mounting hardware 13 that is used to fix the foregoing Fresnel lens sheet 12 onto the foregoing light transmissive panel 10 by

means of a double-sided adhesive tape 19 or the like, for example.

In the above structure, it is made possible for the lenticular lens sheet 11 to expand or shrink freely even when the ambient temperature changes by creating a clearance C, which is a little bit larger than the thickness T of the lenticular lens sheet 11, between the light transmissive panel 10 and the Fresnel lens sheet 12, and there will be no gaps created between the lenticular lens sheet 11 and the Fresnel lens sheet 12 due to partial deformations of the lenticular lens sheet 11. Furthermore, there will be no danger of the lenticular lens sheet 11 getting disengaged since it is sandwiched between the light transmissive panel 10 and the Fresnel lens sheet 12.

Thus, according to the screen device of the present invention in spite of its compactness, it has become possible to obtain images that are free of inconsistencies in color by keeping the lenticular lens sheet and Fresnel lens sheet always in close contact with each other to prevent waving of the lenticular lens sheet caused by temperature changes.

Claims

1. A screen device comprising:

a screen composed of a lenticular lens sheet and a Fresnel lens sheet; and

a framework on which said screen is mounted,

and characterized by:

having the lower part of said lenticular lens sheet and the lower part of said Fresnel lens sheet put together integrally;

having the upper part of the light radiant side of said lenticular lens sheet and the upper part of said framework put together integrally;

having the lower part of said screen, where the lenticular lens sheet and Fresnel lens sheet are put together integrally, not held down integrally to the lower part of said framework; and

having a specified clearance created between said screen except for the area thereof, where the upper part of the light radiant side of said lenticular lens sheet and the upper part of said framework are put together integrally, and said framework.

2. A screen device comprising:

a screen composed of a lenticular lens sheet

and a Fresnel lens sheet, both not being put together integrally with each other; and

a light transmissive panel, which said screen is mounted on and is put together integrally with said Fresnel lens sheet by means of mounting hardware with a specified clearance created on the light radiant side thereof,

and

characterized by having said lenticular lens sheet hanging freely within said clearance created between said light transmissive panel and Fresnel lens sheet.

Fig. 1

- | | |
|--|--|
| 1 Lenticular Lens Sheet | 2B Lower Part of Light Radiant
Side of Fresnel Lens Sheet |
| 1A Upper Part of Light Radiant
Side of Lenticular Lens Sheet | 3 Framework |
| 1B Lower Part of Light Incident
Side of Lenticular Lens Sheet | 4 Mounting Hardware |
| 2 Fresnel Lens Sheet | 5 Screw |
| | 9 Double-Sided Adhesive Tape |

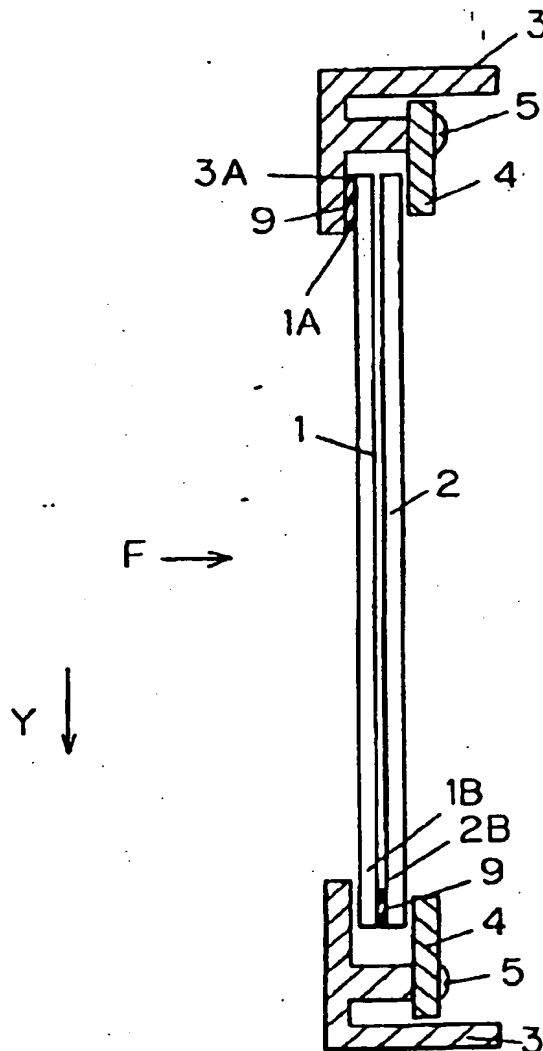


Fig. 2

10 Light Transmissive Panel

11 Lenticular Lens Sheet

12 Fresnel Lens Sheet

13 Screen Mounting Hardware

19 Double-Sided Adhesive Tape

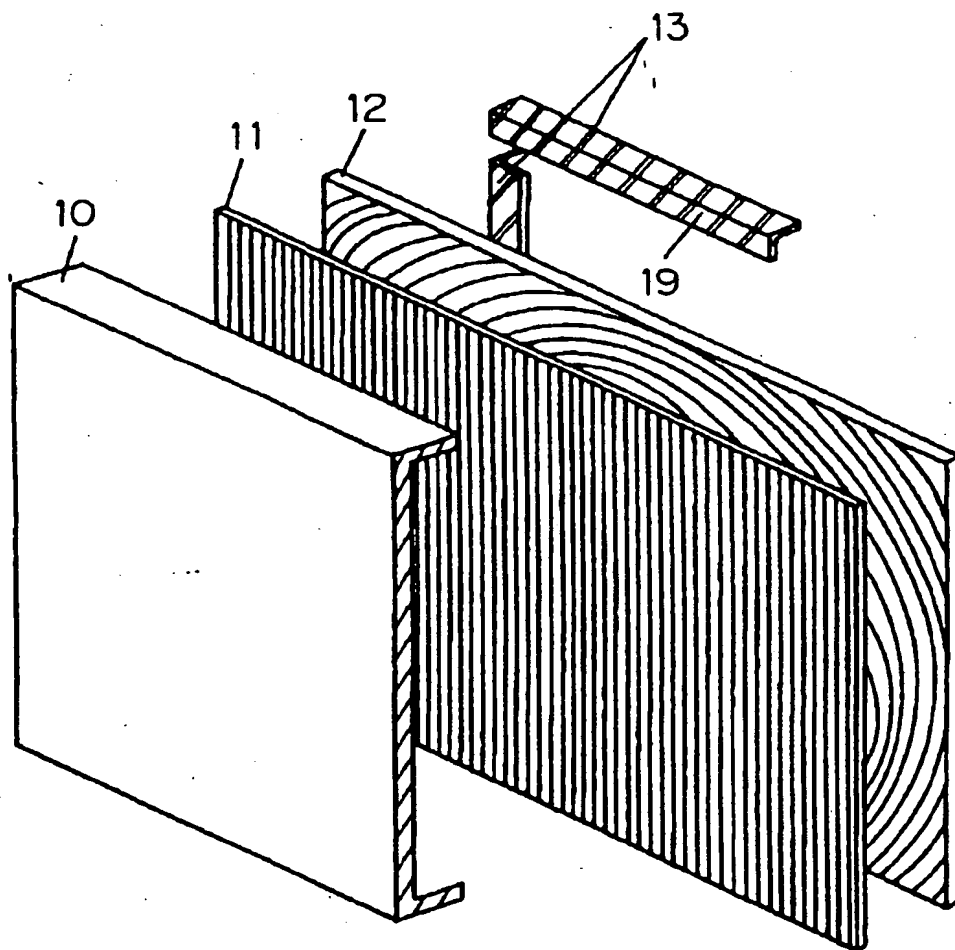


Fig. 3

- 10 Light Transmissive Panel
- 11 Lenticular Lens Sheet
- 12 Fresnel Lens Sheet
- 13 Screen Mounting Hardware
- 19 Double-Sided Adhesive Tape

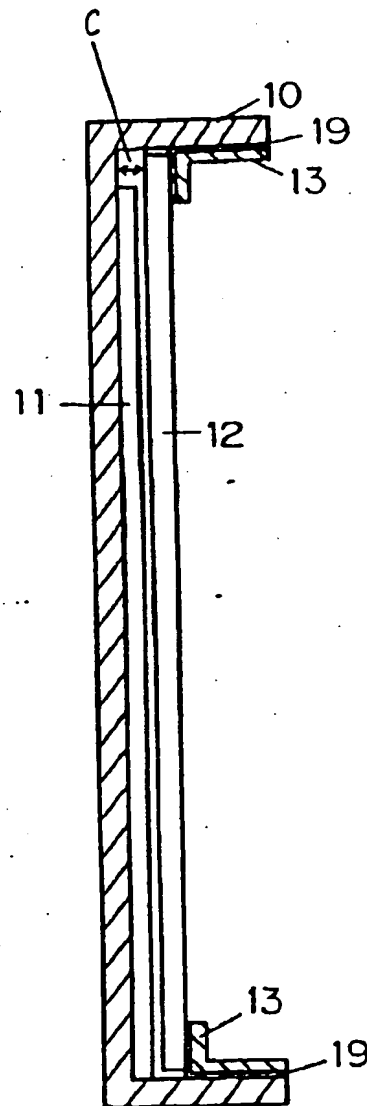


Fig. 4

Prior Art

101 Lenticular Lens Sheet

102 Fresnel Lens Sheet

104 Framework

106 Screw

109 Double-Sided Adhesive Tape

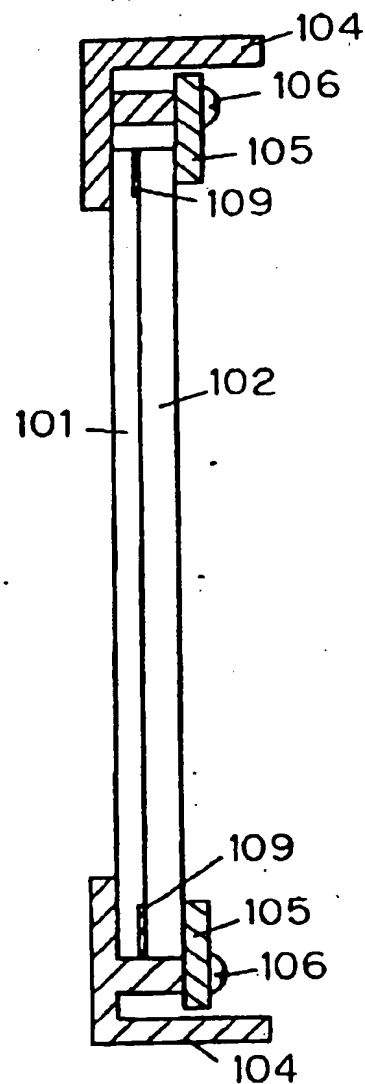


Fig. 5

Prior Art

201 Screen

202 Framework

203 Jig

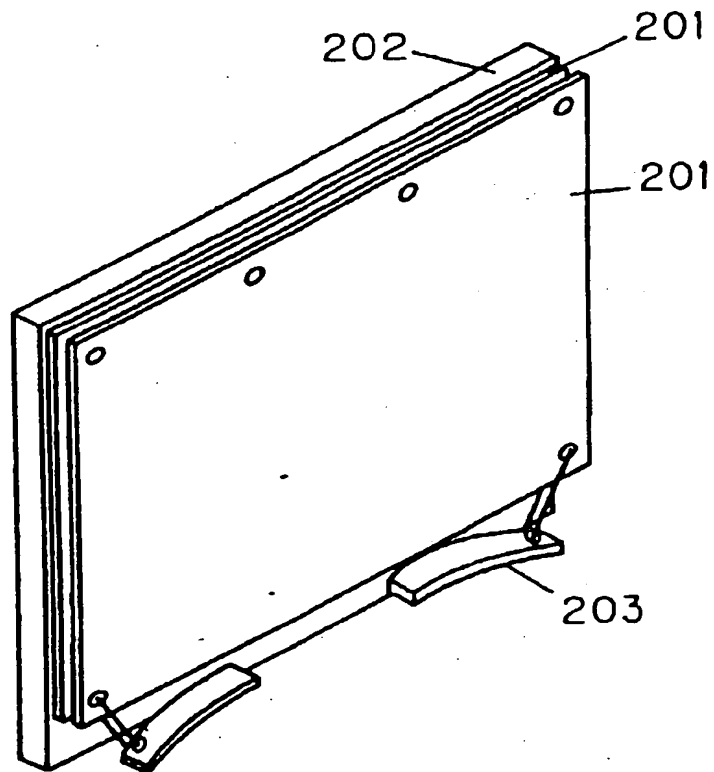


Fig. 6

2nd Art

301 Screen

302 Framework

303 Roller

304 Mounting Hardware

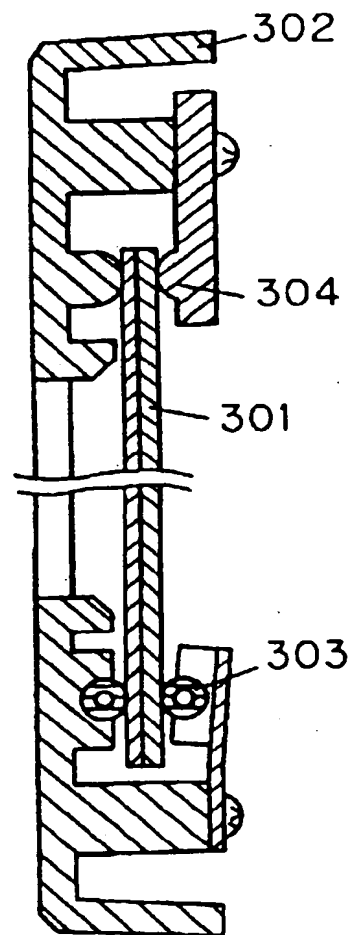


Fig. 7

Prior Art

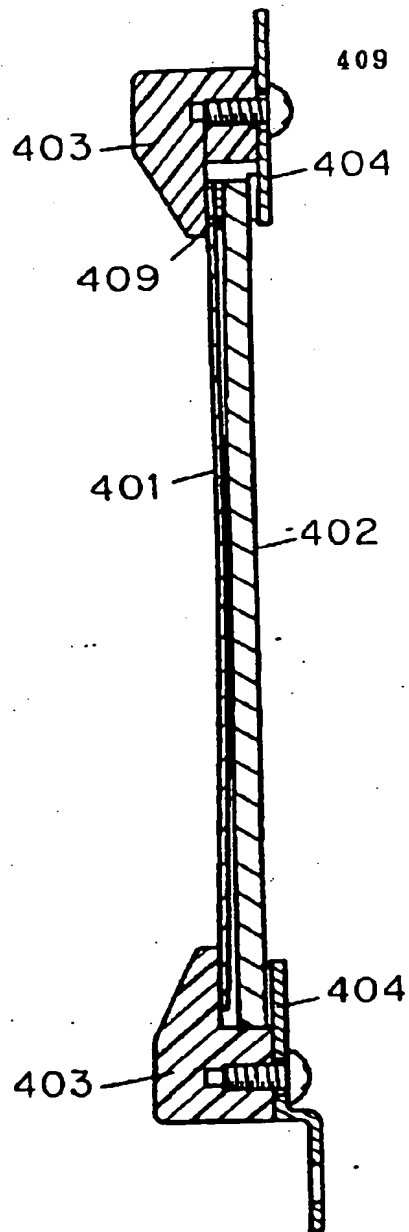
401 Lenticular Lens Sheet

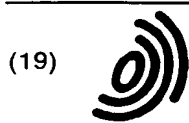
402 Fresnel Lens Sheet

403 Framework

404 Mounting Hardware

409 Double-Side Adhesive Tape





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(71) Applicant: MATSUSHITA ELECTRIC INDUSTRIAL
CO., LTD.
Kadoma-shi, Osaka 571 (JP)

(72) Inventors:
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A.A. THORNTON & CO.
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(57) Rear projection screen having a lenticular lens sheet (1) and a Fresnel lens (2) facing to each other and mounted on a rectangular frame (3).

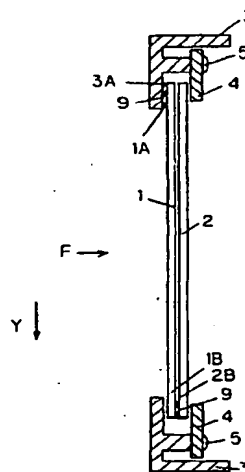
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In a second embodiment the lenticular lens sheet (11) is freely placed between a transparent front plate (10) and the Fresnel lens (12), which are both attached to the frame.

Both embodiments enable the lenticular sheet to have thermal expansion without suffering surface deformations.

Fig. 1

- | | |
|---|---|
| 1 Lenticular Lens Sheet | 2B Lower Part of Light Radiant Side of Fresnel Lens Sheet |
| 1A Upper Part of Light Radiant Side of Lenticular Lens Sheet | 3 Framework |
| 1B Lower Part of Light Incident Side of Lenticular Lens Sheet | 4 Mounting Hardware |
| 2 Fresnel Lens Sheet | 5 Screw |
| | 9 Double-Sided Adhesive Tape |



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EUROPEAN SEARCH REPORT

Application Number
EP 96 30 4832

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	US-A-5 200 854 (OGINO MASANORI ET AL) 6 April 1993 * column 1, line 22 - line 25 * * column 10, line 28 - line 61; figure 13 *	1	G03B21/56 G03B21/62
A	US-A-4 536 056 (OGUINO MASANORI) 20 August 1985 * column 1, line 14 - line 25; figure 1 *		
A	US-A-5 289 311 (MCCLELLAND SANDRA K ET AL) 22 February 1994 Abstract and figure 2	1	
X	PATENT ABSTRACTS OF JAPAN vol. 017, no. 703 (P-1666), 22 December 1993 & JP-A-05 241110 (SONY CORP), 21 September 1993, * abstract * * figures 1-3 *	2	
X,P	EP-A-0 706 077 (HITACHI LTD) 10 April 1996 * page 8, line 44 - line 52 *	2	
A	US-A-4 921 330 (TAKAHASHI MOTOO ET AL) 1 May 1990 Abstract and figs. 1-2	2	
The present search report has been drawn up for all claims			
Place of search MUNICH		Date of completion of the search 19 December 1996	Examiner Aratari, R
<p>CATEGORY OF CITED DOCUMENTS</p> <p>X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document</p> <p>T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons</p> <p>& : member of the same patent family, corresponding document</p>			

EPO FORM 1503 03/92 (P/MCOH)



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CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing more than ten claims.

- ☐ All claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for all claims.
- ☐ Only part of the claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims and for those claims for which claims fees have been paid,
namely claims:
- ☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirement of unity of invention and relates to several inventions or groups of inventions,
namely:

see sheet -B-

- ☒ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.
- ☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid,
namely claims:
- ☐ None of the further search fees has been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims,
namely claims:

**LACK OF UNITY OF INVENTION**

The Search Division considers that the present European patent application does not comply with the requirement of unity of invention and relates to several inventions, namely:

1. **CLAIM 1** : Projection screen wherein a lenticular lens sheet is suspended from its upper edge to a frame and is tensed downwards by the weight of a Fresnel lens plate attached to the bottom edge of the lenticular lens sheet
2. **CLAIM 2** : Projection screen wherein a lenticular lens sheet is freely placed between a light transmissive panel and a Fresnel lens plate